

Claims

- [c1] 1. An ultrafine modified $\text{Al}(\text{OH})_3$ having diffraction peaks by XRD spectrum at the locations that D values are 6.39, 6.16, 4.67 Å, and 2θ are 13.836, 14.347, and 19.006, respectively.
- [c2] 2. An ultrafine modified $\text{Al}(\text{OH})_3$ of Claim 1, wherein the intensities of diffraction peaks where 2θ are 13.836 and 19.006 are 29.12% and 56.10% of the diffraction peak where 2θ is 14.347.
- [c3] 3. The ultrafine modified $\text{Al}(\text{OH})_3$ of Claim 1, wherein the ultrafine modified $\text{Al}(\text{OH})_3$ has an initial weight loss temperature of 330 to about 380°C, and the rate of weight loss is up to 51% at 600°C.
- [c4] 4. The ultrafine modified $\text{Al}(\text{OH})_3$ of Claim 3, wherein the initial weight loss temperature is about 350 to about 370°C.
- [c5] 5. The ultrafine modified $\text{Al}(\text{OH})_3$ of Claim 1, wherein the mean particle size is less than 300nm.
- [c6] 6. The ultrafine modified $\text{Al}(\text{OH})_3$ of Claim 5 wherein the mean particle size is less than 250nm.

- [c7] 7The ultrafine modified $\text{Al}(\text{OH})_3$ of Claim 1 wherein the mean particle size is 300 to about 10 nm.
- [c8] 8. The ultrafine modified $\text{Al}(\text{OH})_3$ of Claim 1 wherein the density is 0.6 to about 1.1 g/cm^3 and the loose density is 0.5 to about 0.9 g/cm^3 .
- [c9] 9. The ultrafine modified $\text{Al}(\text{OH})_3$ of Claim 1 wherein the density is about 0.74 to about 1.04 g/cm^3 , and the loose density is about 0.54 to about 0.83 g/cm^3 .
- [c10] 10. A method of preparing ultrafine modified $\text{Al}(\text{OH})_3$, comprising the steps of:
(A) 1) introducing a CO_2 -containing gas and a NaAlO_2 solution into a high gravity rotating bed apparatus, 2) reacting to form a reactant composition in the form of a gel or a liquid suspension, 3) filtering and washing to obtain a particulate $\text{Al}(\text{OH})_3$ filter cake, and 4) optionally drying the filter cake to obtain a powdered product; wherein the gas/liquid volume flow rate is 0.5 to about 10, on the basis of standard pure CO_2 , and the concentration of NaAlO_2 is 0.1 to about 10 mol/L; and
(B) 5) mixing the particulate $\text{Al}(\text{OH})_3$ obtained in Step A, with a modifying agent selected from the group consisting of an oxalate, an oxalic acid, or a mixture thereof, 6) reacting for a predetermined period of time at a temper-

ature equal to or higher than 100 °C; and 7) drying the reacted $\text{Al}(\text{OH})_3$ to obtain an ultrafine modified $\text{Al}(\text{OH})_3$ powder product.

- [c11] 11. The method of preparing ultrafine modified $\text{Al}(\text{OH})_3$ of Claim 10 wherein the concentration of NaAlO_2 is about 1 to about 8 mol/L.
- [c12] 12. The method of preparing ultrafine modified $\text{Al}(\text{OH})_3$ of Claim 10 wherein the reaction temperature in Step B is less than 205°C.
- [c13] 13. The method of preparing ultrafine modified $\text{Al}(\text{OH})_3$ of Claim 12 wherein the reaction temperature in Step B is 140–180°C.
- [c14] 14. The method of preparing ultrafine modified $\text{Al}(\text{OH})_3$ of Claim 10 wherein the molar ratio of modifying agents in Step B to $\text{Al}(\text{OH})_3$ filter cake or powder from Step A is 0.3 to about 2; and said modifying agents are in the form of a solid or a solution.
- [c15] 15. The method of preparing ultrafine modified $\text{Al}(\text{OH})_3$ of Claim 10 wherein the gas/liquid volume rate is 0.1 to about 5 in Step A, on the basis of standard pure CO_2 , and the reaction temperature is 20 to about 80°C.
- [c16] 16. The method of preparing ultrafine modified $\text{Al}(\text{OH})_3$

of Claim 10 wherein pH value of the reactant composition is controlled to greater than or equal to 8 in Step A.

[c17] 17. The method of preparing ultrafine modified $\text{Al}(\text{OH})_3$ of Claim 16 wherein the pH is 8 to about 13.

[c18] 18. The method of preparing ultrafine modified $\text{Al}(\text{OH})_3$ of Claim 10 wherein the oxalate is selected from a lithium, sodium and potassium oxalate.

[c19] 19. The method of preparing ultrafine modified $\text{Al}(\text{OH})_3$ of Claim 10 wherein the activator and the crystal form controlling agent are added into Step A, into Step B, or both, and the activator is selected from the group consisting of fatty acid and its salt, ester aluminate, and ester titanate, and the crystal form controlling agent is selected from sulfate and phosphate.

[c20] 20. A method of preparing ultrafine $\text{Al}(\text{OH})_3$, comprising the steps of: introducing a CO_2 -containing gas and a NaAlO_2 solution into a high gravity rotating bed apparatus, reacting and generating a reactant composition comprising a gel or a liquid suspension of $\text{Al}(\text{OH})_3$; filtering and washing the reactant composition to obtain an $\text{Al}(\text{OH})_3$ filter cake, and optionally drying the filter cake to obtain a powdered product; wherein the gas/liquid volume flow rate is 0.5 to about 10, on the basis of stan-

dard pure CO_2 and wherein the concentration of NaAlO_2 is 0.1 to about 10 mol/L.

- [c21] 21. The method of preparing ultrafine modified $\text{Al}(\text{OH})_3$ of Claim 20 wherein the concentration of NaAlO_2 is about 1 to about 8 mol/L.
- [c22] 22. The method of preparing ultrafine modified $\text{Al}(\text{OH})_3$ of Claim 20 wherein the pH value of the reactant composition is greater than or equal to 8.
- [c23] 23. The method of preparing ultrafine modified $\text{Al}(\text{OH})_3$ of Claim 22 wherein the pH is 8 to about 13.
- [c24] 24. The ultrafine $\text{Al}(\text{OH})_3$ product prepared by the method of Claim 10.
- [c25] 25. The ultrafine $\text{Al}(\text{OH})_3$ product of Claim 24, wherein in the method the pH value of the reactant composition is greater than or equal to 8.
- [c26] 26. A fire retardant product comprising an ultrafine modified $\text{Al}(\text{OH})_3$ as a fire retardant, the ultrafine modified $\text{Al}(\text{OH})_3$ having diffraction peaks by XRD spectrum at the locations that D values are 6.39, 6.16, 4.67 Å, and 2θ are 13.836, 14.347, and 19.006, respectively.
- [c27] 27. The fire retardant product of Claim 26, wherein the intensities of diffraction peaks where 2θ are 13.836 and

19.006 are 29.12% and 56.10% of the diffraction peak where 2θ is 14.347.

- [c28] 28. The fire retardant product of Claim 26, wherein the ultrafine modified $\text{Al}(\text{OH})_3$ has an initial weight loss temperature of 330 to about 380°C, and the rate of weight loss is up to 51% at 600°C.
- [c29] 29. The fire retardant product of Claim 26, wherein the mean particle size is less than 300nm.
- [c30] 30. The fire retardant product of Claim 26 wherein said the density is 0.6 to about 1.1 g/cm³.